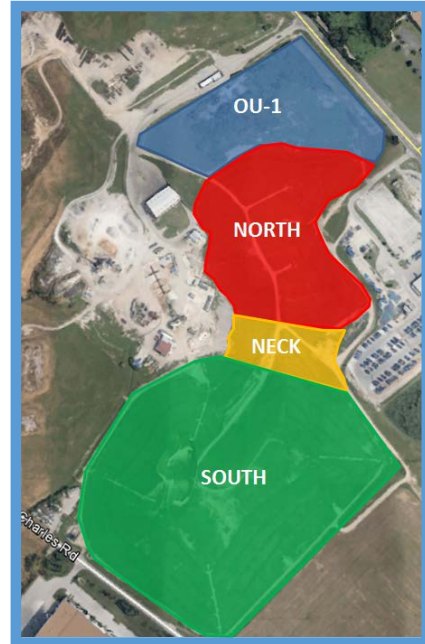


Bridgeton Landfill Data Review Update

Primarily Reflects Data and Documents Published on MDNR's Webpage for data collected in January 2016

Introductory Remarks

The ORD Engineering Technical Support Center (ETSC) and their subcontractor reviewed data and reports at the Missouri Department of Natural Resources (MDNR) Bridgeton Landfill website. The purpose of the review was to examine available reported data collected at the landfill gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs) to assess the presence and progression of any subsurface oxidation event/heat-generating event occurring in the South Quarry, North Quarry or the adjoining “Neck” area (*see figure on right for an approximate depiction of these areas and the adjacent Westlake Landfill OU-1 cell*). The shaded areas shown in the figure are intended to provide a quick reference to different areas of interest. This report analyzes data primarily collected during January, 2016.



The South Quarry and North Quarry landfill cells began the closure process in 2008 and 2010, respectively. The landfill cells were covered with a 2-ft thick clay cap (with specified hydraulic conductivity $< 1 \times 10^{-5}$ cm/sec) overlain by a 1-ft thick vegetative soil layer. An ethylene vinyl alcohol (EVOH) flexible membrane cap was placed over the South Quarry, Neck Area, and a portion of the North Quarry in 2013 and 2014. Work was initiated in the South Quarry at various times in 2014 and 2015 to repair slopes that had subsided.

This document provides a summary and discussion of data collected in North Quarry, Neck Area, and South Quarry of the landfill. Observations on the flare data are also provided below:

- The average flow rates of methane (CH_4) (335 standard cubic feet per minute (scfm)) and carbon dioxide (CO_2) (1,126 scfm) to the flare were slightly less than those measured in December 2015. The balance gas flow rate of 1,282 scfm in January, 2016 was slightly greater than that measured in December, 2015 (1,228 scfm).
- The average total flare flow rate of 2,997 scfm in January was slightly less than that measured in December (3,042 scfm).

Flare data are subject to further examination, as subsequent meetings in December 2015 and January 2016 indicate the flow measurements for the overall gas collection system and flares were not accurate, and flow data for these systems were not accurately measured until after March 12, 2015 (per MDNR). However, it is our understanding that flow data from individual GEWs and GIWs were accurate throughout 2015 and into 2016.

North Quarry

Temperature

January 2016 temperature measurements in GEWs showed four wells with a slightly lower than historical temperature. The remaining wells exhibited mostly steady temperatures when compared to December, 2015 data. The maximum temperature measured in North Quarry wells was approximately 144 °F (GEW-54).

Data from several new TMPs in the North Quarry (TMP-16 through 18, and 21 through 29) were examined, and the observed temperatures were all generally steady in January 2016, with a few exceptions. TMP-18, -21, -22, and -23 all showed a similar increases of approximately 2 °F across all depths. This small change may suggest a difference in resistivity in the meter rather than a temperature increase in all of these areas. TMP-26 exhibited an increase of approximately 5 °F at the 20-ft depth.

Three TMPs (-16, -17, and -25) had at least one depth with a measured temperature greater than 160 °F, which is one more location than in December 2015 (only TMP-16 and -17 had a measured temperature greater than 160 °F). This temperature was observed at one depth in TMP-25, and is slightly less than historical highs at the 80 ft depth.

Collected Gas Quality

January 2016 data showed similar trends as in December, with respect to balance gas and pressures (< 2" water column or w.c.) observed in most wells. Some wells showed elevated balance gas concentrations, and laboratory data suggests that in nearly every case the elevated balance gas was composed of nitrogen (N₂). Similar to December, nearly every elevated balance gas measurement was accompanied by a low oxygen (O₂) concentration, suggesting possible air intrusion in the wells with elevated N₂.

Settlement

No settlement data were available for the North Quarry in January 2016.

Neck Area

Temperature

TMP measurements were mostly stable when compared to December 2015 data. Two TMPs showed a continued, slight increase in temperature (TMP-6 at the 15-ft depth, TMP-11 at the 36-ft depth (maximum temperature of approximately 173 °F)).

January 2016 data showed a combination of steady or decreasing temperature trends in the GIWs. This trend is consistent with December 2015 temperatures in the GIWs.

GEWs exhibited either a steady or decreasing temperature trend in January 2016 compared to December 2015 data, consistent with established trends in the past months. Similar to what occurred in December 2015, a few wells exhibited a large drop in temperature that either persisted or rebounded to a temperature similar to December 2015. Not enough data points are available to suggest any prolonged trend, but continued evaluation of this area in subsequent months will enable discernment of trends.

Heat Extraction System (HES) Evaluation

TMPs installed adjacent to GIWs retrofitted with the HES (cooling loop system) were examined and compared to December, 2015 data. The January, 2016 data displayed mostly steady or decreasing temperatures. The TMP-5 HES series all showed steady temperatures. TMP-10-5N showed declining temperatures at two depths (20 and 40 ft). TMP-10-5S showed a decline at each of four depths, with the largest decline at the 40-ft depth of approximately 10 °F. **The 140-ft depth at TMP-20 continued showing a temperature increase** (approximately 5 °F, similar to the month-over-month increase seen from November to December, 2015). **Slight temperature increases were also observed at most depths of TMP-14R.**

Similar to December, the TMPs continued showing higher temperatures than the adjacent GIWs, and the TMPs closer to the GIW generally had lower temperatures than those farther from the GIWs, indicating a localized cooling effect from the HES.

Generally, the temperatures increase with depth, with measured maximum values between 200 °F and 250 °F.

Collected Gas Quality

Half (7 of 14) of the GEWs exhibited elevated balance gas concentrations at least once during January. O₂ concentrations in these wells were all low except at two wells (GEW-109 and -110) in comparison to the amount of balance gas present, which suggests possible air intrusion.

All 13 GIWs exhibited elevated concentrations of balance gas and/or CO₂. Balance gas concentrations were elevated during the entire month, and the majority of GIWs had measured concentrations > 20%. CH₄ concentrations were generally < 20% for the GIWs.

Settlement

Limited elevation points were measured in the Neck Area, thus no assessment of settlement rates in the Neck Area is made here.

South Quarry

Temperature

- **No GEWs with data had temperatures > 200 °F. Thirty-two wells had measured temperatures ranging from 140 °F to 200 °F. Twelve wells had measured temperatures < 100 °F.**
- **56 wells maintained an applied vacuum of at least 2" w.c. for the whole month.**
- **Data from two TMPs (TMP-31 and TMP-32) were examined. No notable temperature increases were noted for both TMPs across all depths.**

Collected Gas Quality

No GEWs in the South Quarry exhibited gas concentrations consistent with anaerobic waste decomposition conditions.

Settlement

The maximum settlement amount in January was 1.53 ft; slightly greater than the maximum measured settlement of 1.28 ft from December, 2015. Surface elevation points reported in January were compared to surface elevation points collected in December, and a volume difference was calculated by analyzing surfaces created with both sets of data points using a computer-aided design (CAD) program. The analysis showed a decrease in volume of approximately 19,000 cubic yards (yd³) from December, 2015 to January, 2016. This is a slight increase in settlement from the approximately 16,000 yd³ volume loss from November to December, 2015. This value should be considered an estimate since there were some settlement points missing from this month's data and details on surface filling or removal activities were not available in the site's monthly report narrative.